

COMPARATIVE LABORATORY STUDY OF PHOSMETHYLAN Brighton, England

L. Szabo, K. Sagi

Research Institute for Heavy Chemical Industries, Veszprem, Hungary

ABSTRACT

The effect of phosmethylan and the influence of temperature and site of application on the toxicity were examined using the bioassay method. Similar effects of the product were observed when used either as contact or as stomach poison. Neither systemic, repellent nor vapour effect of the material was found, but its antifeedent effect is considerable. Treating the head, the thorax and the abdomen topically the most effective treatment was found to be on the thorax. A positive temperature coefficient was found for phosmethylan.

INTRODUCTION

Phosmethylan is an a.i. discovered in 1979 at the Research Institute for Heavy Chemical Industries and registered by the ISO in 1985. The agent was developed and distributed with the trade mark Nevifosz 50 EC. It was introduced to the international public at the ICPP in Brighton in 1983 (Sagi *et al.*, 1983). The results reported there referred mainly to large scale investigations.

In this paper, bioassay examinations have been carried out to determine the mode of action of phosmethylan and some of the factors influencing its effect. Contact, stomach poison, systemic, vapour and antifeedent effects were examined and the effect of temperature and of the site of application on the biological activity were also studied.

MATERIALS AND METHODS

To observe the mode of action the following bioassay tests have been performed.

The separate contact and stomach poison effects were studied on turnip sawfly larvae (*Athalia rosae*), treating leaf discs of the same size, using a micropipette. The contact effect was tested by treating "non host plant" mulberry tree (*Morus alba*) leaves, while the stomach poison effect was studied on winter oilseed rape (*Brassica napus*) using the leaf sandwich method. To observe the simultaneous contact and stomach poison effects winter oilseed rape leaf discs were used for feeding.

The effect of the compound on the feeding of insects was examined on mustard beetle (*Phaedon cochleraria*), on Chinese cabbage (*Brassica chinensis*) and on diamondback moth (*Plutella maculipennis*) on white mustard (*Sinapis alba*) test plants. The effect of time on the number of feeding larvae was observed and the surface area of the leaves eaten was measured with a leaf area meter (Licor Li-300).

When the degree of toxicity and the role of site and temperature of the treatments were tested, 3-5 days old female adults of WHO/SRS house

fly were used. 1 μ l phosmethylan with a purity of 99% was dissolved in acetone and this solution was used for treatment with a microapplicator of type LV.65. 5-7 dose values were applied for each variation, with 3 replications per dose, with 20 flies per replication. The tests were carried out at a temperature of $24 \pm 1^\circ\text{C}$ and relative humidity of $65 \pm 5\%$. The data obtained were evaluated by probit analysis.

To find a connection between the degree of toxicity and the place of treatment, the head, the dorsal part of the thorax and the ventral part of the abdomen were treated. Tests were performed at temperatures of 15, 20, 25 and 30°C to discover the relationship between toxicity and temperature.

RESULTS

Apoplastic, symplastic and translaminar translocation of the phosmethylan, penetration from the one side of the leaf to the other side or vapour and repellent effects were not proved with biological indicator organisms.

The results of the separate and simultaneous contact and stomach poison tests are given in Table 1. In the case of high dose values ($5.6 \mu\text{g}/\text{cm}^2$) activities equalling or approaching 100% were found for all of the tests, while with lower doses ($2.8 \mu\text{g}/\text{cm}^2$) the mortality caused by the separate contact and stomach poison effects is less than that of the simultaneous action.

TABLE 1

Test of the separate and simultaneous contact and stomach poison effects of phosmethylan on turnip sawfly larvae (L_3)

Method of test	Dose a.i. ($\mu\text{g}/\text{cm}^2$)	Mortality after 24 hours (%)
Contact	5.6	100
	2.8	82
Stomach poison	5.6	97
	2.8	78
Simultaneous contact and stomach poison effect	5.6	100
	2.8	100

The feeding after treatment is given in Fig. 1 for mustard beetle and in Fig. 2. for diamondback moth larvae. The results of the consumption of leaf area are given in Table 2, compared with untreated leaf as a blank.

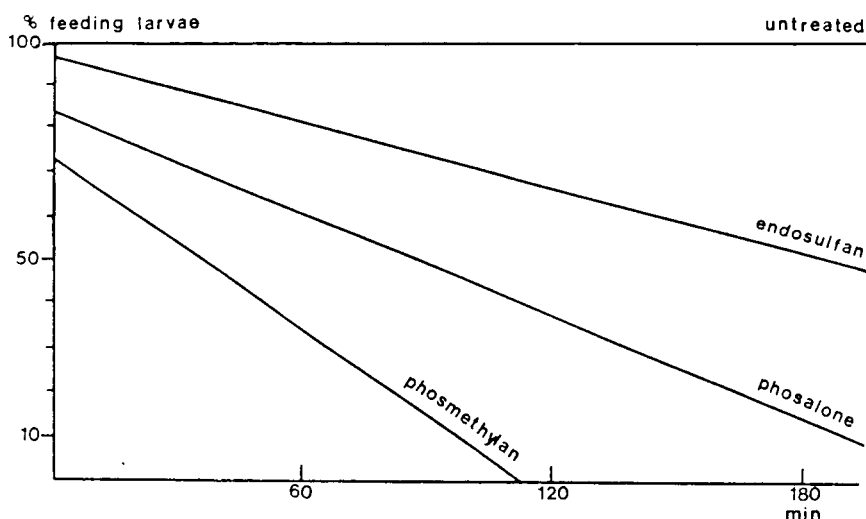


Fig. 1. Food consumption of *P. cochlerariae* (L₄) after treating the leaves with 125 mg a.i./l. Ratio of feeding larvae plotted against time, %.

phosmethylan $Y' = 73.83 - 0.43X$ $b = 0.43 \pm 0.06$ $r = -0.91$

endosulfan $Y' = 104.94 - 0.31X$ $b = 0.31 \pm 0.03$ $r = -0.96$

phosalone $Y' = 84.45 - 0.43X$ $b = 0.43 \pm 0.04$ $r = -0.96$

untreated $Y' = 96.00 - 0.1X$ $b = 0.1 \pm 0.01$ $r = -0.7$

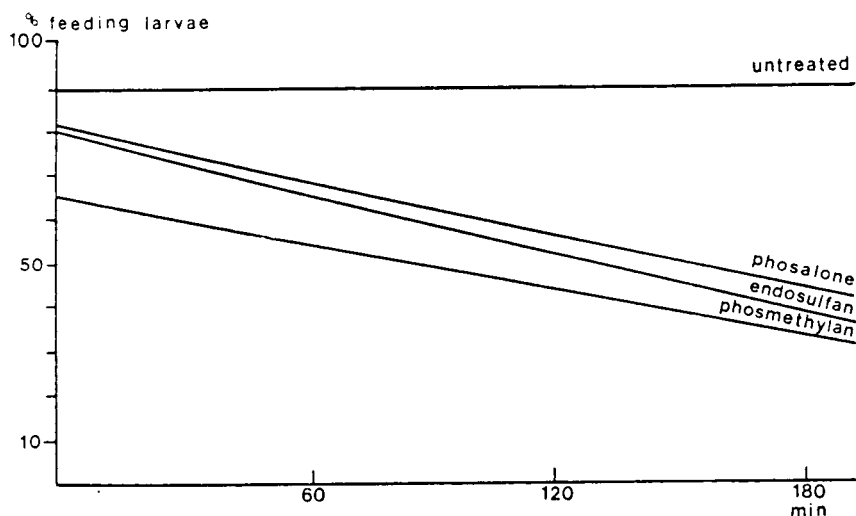


Fig. 2. Food consumption *P. maculipennis* (L₃) after treating the leaves with 125 mg a.i./l. Ratio of feeding larvae plotted against time, %.

phosmethylan $Y' = 71.86 - 0.25X$ $b = -0.25 \pm 0.66$ $r = -0.8$

endosulfan $Y' = 81.62 - 0.26X$ $b = -0.26 \pm 0.04$ $r = -0.91$

phosalone $Y' = 81.33 - 0.24X$ $b = -0.24 \pm 0.04$ $r = -0.89$

untreated $Y' = 89.76 - 0.1X$ $b = -0.1 \pm 0.01$ $r = -0.8$

TABLE 2

Feeding of mustard beetle L₄ (PHA) and diamondback moth L₃ (PLU) larvae after a dipping with 125 mg a.i./l for 185 minutes of observation.

Treatment	Food consumption as a % of the untreated	
	PLU	PHA
Phosmethylan	53.4	24.8
Endosulfan	48.0	91.2
Phosalone	67.5	77.9
Untreated	100.0	100.0

It is known from the literature that in the case of topical application, the degree of toxicity of insecticides depends on the site of application (Hewlett and Gostick, 1963; Ahmed and Gardiner, 1968). Similar differences in dose-effect values were found for phosmethylan applied on the three different parts of the insects. In the first series of experiments (Table 3) the LD₅₀ value measured on the thorax is significantly lower than that on the head and is not significantly lower than on the dorsal. In the second series of experiments the phosmethylan proved to be significantly more effective on the thorax than either on the head or on the dorsal part.

TABLE 3

Dose-response data for phosmethylan topically applied to the various body parts of adult *Musca domestica* L.

No. of test	Site of application	LD ₅₀ ($\mu\text{g}/\text{q}$)	Fiducial-limits (95%)		Slope	±	SE
			Lower	Upper			
1	Head	0.98	0.87	1.09	2.91	±	0.42
	Thorax	0.54	0.49	0.59	4.29	±	0.73
	Abdomen	0.61	0.56	0.67	4.18	±	0.78
2	Head	1.88	1.54	2.29	1.96	±	0.42
	Thorax	1.09	0.91	1.30	2.68	±	0.50
	Abdomen	1.47	1.30	1.66	3.78	±	0.69

The knowledge of the relationship between toxicity and temperature is crucial from the point of view of practical plant protection. From the results of phosmethylan tests performed with house flies the conclusion can be drawn that this material has a positive temperature coefficient (Fig. 3). This observation is confirmed by the results of both series of experiments, though significant differences were found only in the first series of experiments (Table 4). There is no considerable difference between the results obtained at 20°C and 25°C. On the other hand the toxicity of the phosmethylan is significantly lower at 15°C and significantly higher at 30°C than at the temperatures listed above. The doubled value of toxicity at 30°C compared with that at 25°C is especially remarkable.

TABLE 4

Dose-response data for phosmethylan topically applied to the WHO/SRS housefly at different temperature in two series of experiments.

No. of test	Temperature (°C)	LD ₅₀ (µg/♀)	Fiducial-limits (95%)		Slope	±	SE
			Lower	Upper			
1	15	2.01	1.79	2.25	2.94	±	0.44
	20	1.48	1.35	1.64	3.75	±	0.59
	25	1.46	1.30	1.63	3.04	±	0.51
	30	0.69	0.62	0.78	2.69	±	0.34
2	15	1.92	1.70	2.18	2.55	±	0.39
	20	1.76	1.58	1.97	2.93	±	0.42
	25	1.55	1.40	1.73	3.07	±	0.43
	30	1.34	1.22	1.48	3.68	±	0.52

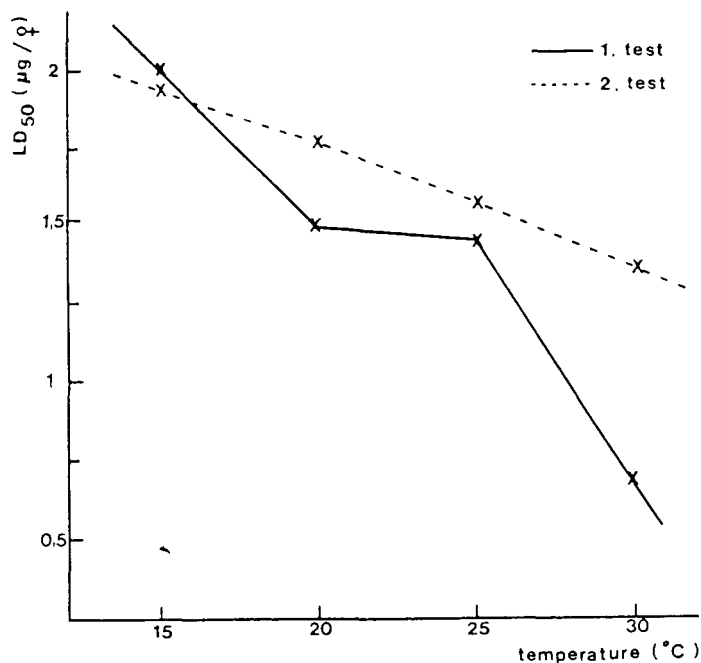


Fig. 3. LD₅₀ values for phosmethylan plotted against different temperature.

DISCUSSION

From the results of the tests carried out to discover the mode of action of the phosmethylan, the conclusion can be drawn that the compound has contact and stomach poison effects. Systemic, vapour and repellent effects were not proved with test organisms. Nevertheless the food consumption of mustard beetle and diamondback moth was considerably hindered.

By applying topical treatments on different parts of the body of flies it was observed that the best results can be obtained, if the treatment is performed on the thorax.

The toxicity of insecticides is influenced by several factors, one of which is temperature. Some insecticides have higher toxicity at higher temperature (organophosphates, carbamates), while others have lower toxicity at higher temperature (DDT, pyrethroids). The positive temperature dependence of the insecticide is demonstrated by the tests carried out with phosmethylan on house flies. In one test the efficiency at 30°C is more than twice that at either 20°C or 25°C.

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